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Exploring the Impact of First-Time ESG Rating on Stock Price Informativeness and Liquidity

A Comparative Study of Rated and Non-Rated Firms in the US Stock Market

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Abstract

This thesis examines whether being covered by a ESG rating agency translates into more informative stock prices in the US stock market, and whether this enhancement of stock price informativeness impacts the stock liquidity of rated firms. By employing price nonsynchronicity as a proxy for stock price informativeness, our study reveals that ESG-rated firms exhibit a 4.3% higher level of price informativeness compared to non-rated firms. Additionally, our findings suggest that rated firms exhibit notable improvements in liquidity, as evidenced by a 3.5% reduction in the relative bid-ask spread and a 16.5% decrease in the Amihud illiquidity ratio. However, our analysis does not provide empirical evidence to suggest that the increase in liquidity is driven by the elevation of stock price informativeness. Overall, our research presents compelling evidence that rating agencies serve as dependable sources of ESG information in the US stock market, but not that this information itself plays a direct role in boosting stock liquidity.

Acknowledgements

This thesis marks the completion of our Master of Science (MSc) degree in Financial Economics at the Norwegian School of Economics (NHH).

Our motivation to write this thesis comes from the growing body of literature on sustainable investing, and the potential impact it has on financial markets and corporate behavior. We hope that our research provides a valuable contribution to this literature, and that it provides useful insights to investors, academics, and policymakers.

We would like to express our sincerest gratitude to our supervisor, Darya Yuferova, for her stimulating input and support over the course of writing this thesis. We greatly appreciate your willingness to share ideas and suggestions, as they have helped us shape this thesis into a product of which we can be proud of. Furthermore, we would like to thank the department of finance and the library staff at NHH for providing us access to essential data. Lastly, we wish to thank our friends and family for their continuous encouragement throughout writing this thesis and our studies at NHH.

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1. Introduction

One of the primary roles of financial markets is generating and consolidating information. This is achieved through the process of trading, which enables the transmission of information created by traders' own speculative purposes into stock prices (Glosten & Milgrom 1985, Kyle 1985). In efficient markets, stock prices only respond to events that are not already anticipated by the market (Fama 1970). Hence, when firms' information environment improves, market participants can enhance their predictions about future firm-specific events. If current stock prices are highly informative, they are likely to already reflect the probability of such events occurring, leading to less firm-specific variation in future stock prices.

In recent years, ESG has become crucial for various stakeholders assessing corporate performance and image, increasing the demand for accurate and reliable ESG information. The US SIF[1] Foundation (2020) reported that investors were considering ESG factors across $17 trillion worth of assets in 2020, a 42% increase since 2018. This signals a significant shift in investor preferences towards sustainable investing. Hence, investors seeking to execute these trades, are dependent on reliable information about firms' ESG practices to make informed decisions. Although many publicly listed firms provide their own ESG disclosure statements, it stands to argue that the typical investor does not have the resources nor the time to perform detailed ESG evaluations of firms (Marhfor et al. 2013). As a result, the number of firms covered by ESG rating agencies have increased substantially in recent years.[2] With the goal of enhancing transparency for investors, rating agencies provide distinct ESG scores to firms, which objectively and comprehensively evaluates firms' ESG practices to the financial markets.

In the US stock market, numerous firms disclose their own ESG information, but not all of them are covered by a rating agency. Although several studies (Chen, Yang, Zhang & Wang 2023, Eccles et al. 2014) use these ESG ratings as indicators for strong ESG performance, no study has yet investigated the actual informational impact these rating agencies have on stock prices, nor the influence they have on stock performance. From the perspective of empirical finance, this thesis explores whether the coverage of a rating agency has an impact on the stock price informativeness

[1]The Forum for Sustainable and Responsible Investing (US SIF) is the leading voice advancing sustainable investing across all asset classes in the United States.

[2]The development of firms that are covered by Thomson Reuters on the NASDAQ is illustrated in Section 2.2.

(SPI)[3] of firms in the US stock market, compared to those that are not covered. Additionally, we aim to comprehend how any potential alteration in SPI directly affects the liquidity of covered firms. Consequently, our ultimate objective is to establish a causal relationship between ESG-coverage and stock liquidity, solely through the channel of SPI.

Our study documents three primary empirical results. First, by employing price nonsyncronicity as a measure for SPI, we find that firms with ESG-coverage exhibit a significant increase in SPI by 4.3 percentage points compared to non-rated firms, indicating that rating agencies in fact are reliable providers of ESG information to US financial markets. Second, employing the relative bid-ask spread and the Amihud illiquidity ratio as indicators of liquidity, we observe a significant increase of respectively 3.8 and 16.5 percentage points in liquidity for rated firms, indicating a positive relationship between ESG-coverage and liquidity. Lastly, we do not find any significant relationship between first-time ESG ratings and liquidity through the channel of SPI, indicating that SPI is not a significant driver in this relationship. Although ESG-coverage results in more informative stock prices, we do not find any evidence that this additional information itself impacts stock liquidity for covered firms.

This thesis offers three major contributions to previous literature. First, no prior studies shed light on the impact of first-time ESG-coverage on stock liquidity. Most prior research has focus on the relationship between ESG disclosures and stock return, yielding mixed results. Majority of studies suggest that firms with higher ESG scores tend to generate higher average returns (Kempf & Osthoff 2007, Edmans 2011, Luo 2022), arguing that these firms have better reputation and lower risk profiles, attracting more investors. On the contrary, other studies find the opposite relationship (Renneboog et al. 2008, Hong & Kacperczyk 2009, Hwang et al. 2021), arguing that ESG is already incorporated into stock prices under market mechanisms, and that it limits available investing options, reducing diversification. Our observations are that these contradicting results are mainly due to differences in sampling period and what stock exchanges are studied. Studies covering more recent years of data and US stock exchanges usually support a positive relation between ESG and return.[4] Not until recently have there been studies directly investigating the relation between ESG and liquidity, suggesting a positive relationship (Chen, Liu, Jiang & Liu 2023, Chung et al. 2010). However, these studies focus only on emerging markets.

Second, this thesis hypothesizes that a change in SPI is an underlying driver in the relationship between first-time ESG-coverage and stock liquidity. There are no prior studies investigating the direct effect first-time ESG-coverage has on SPI. However, a study by Marhfor et al. (2013) analyzed the link between financial analyst coverage and SPI in both developed and emerging markets. While the study found that increased financial coverage decreased SPI in emerging mar-

[3] In accordance with Ng & Rezaee (2020), the acronym «SPI» will be employed to refer to stock price informativeness throughout this thesis.

[4] These studies are further discussed in section 3.1.

kets, it found that more coverage enhanced the amount of firm specific information incorporated into stock prices for developed markets. Recent studies have also analyzed the link between ESG ratings and SPI (Ng & Rezaee 2018). However, neither of them study the role rating agencies play in terms of information flow in financial markets, motivating us to study the later topic.

Lastly, this thesis contributes to the growing body of research on the link between ESG and stock performance in the world's largest economy. While many studies exploring the connection between ESG and stock returns use samples from the US stock market, those that study the connection between ESG and liquidity do not. According to the Scope Group (2021) US firms are at the forefront of ESG transparency. This, coupled with the significant shift in investors' preferences towards sustainable investing, highlights the crucial importance of ESG in the United States, motivating us to study this market. Our inspiration to explore the NASDAQ,[5] in particular, arises from its renowned emphasis on higher-growth technology firms, presenting a highly relevant focal point for ESG related investigation. Moreover, the World Federation of Exchanges (WFE 2022) reported that in 2021, NASDAQ recorded among the highest annual trading volumes globally, highlighting the wealth of data for our comprehension of SPI and liquidity.

This thesis has implications for our understanding of liquidity, the role of rating agencies in financial markets, and for policy researchers and regulatory authorities concerned with sustainable investing. First, our finding that ESG-covered firms experience an increase in liquidity is beneficial for investors prioritizing the ease of buying and selling stocks. These firms may have a higher trading volume, indicating higher efficiency and lower transactions costs for investors. Moreover, the lack of a significant relationship between ESG-coverage and liquidity, through the channel of SPI suggests that liquidity is driven by other factors beyond the integration of ESG information into stock prices. Second, our finding that ESG-coverage have a significant effect on SPI and liquidity separately have a strong implication for rating agencies themselves. It suggests that these agencies have a meaningful role in financial markets, and a strong impact on sustainable investing. Lastly, policy researchers and regulatory authorities can use our findings to consider integrating requirements for ESG-coverage into their regulatory frameworks, and encourage the development of more standardized reporting framework for ESG, to further facilitate transparency for investors.

The remainder of this thesis is structured as follows. Chapter 2 provides background insight into the principles of ESG and Thomson Reuters. Chapter 3 reviews previous literature on market efficiency, SPI and stock liquidity. Chapter 4 discusses the collection and treatment of our data, while Chapter 5 presents our empirical model and methodology. Our results are presented and discussed in Chapter 6, which is followed by concluding remarks in Chapter 7. Lastly, a discussion of further research is presented in Chapter 8.

[5]National Association of Securities Dealers Automated Quotations Stock Market (NASDAQ)

2. Background

2.1 The Principles of ESG

In the latter part of the 19th century, the notion of social responsibility began to emerge. The first wealth management firms placed limitations on investments in the "sin-industries," such as tobacco and alcohol, which marked the genesis of Social Responsible Investing (SRI) (Roselle 2016). Since then, SRI has been a crucial aspect of managing external stakeholders. During the 1950s, Patrick Murphy introduced the idea of Corporate Social Responsibility (CSR) (Carroll 2009), which suggests that companies have certain social responsibilities to themselves, shareholders, and society beyond its legal obligations (Smith 2003). This promoted the idea that firms engaging in CSR activates, can achieve more than just favorable stakeholder attitudes, but in the long run, also build a positive corporate image and enhance stakeholder´s advocacy behavior (Du et al. 2010).

The concept of ESG gained significant traction in the early 2000s through the European Union's "Who Cares Wins" report with the aim of creating strong and resilient financial markets that prioritizes transparency and sustainability (Compact 2004). The environmental pillar of ESG assesses a company's impact on the natural world. It includes factors such as energy consumption, biodiversity, waste management, and carbon emissions. The social pillar of ESG evaluates a company's relationships with stakeholders such as customers, suppliers, and employees. Firms that prioritize human rights, labor standards, and diversity usually score well on this factor. The governance pillar of ESG evaluates a company's systems and structures for managing operations, ensuring accountability to stakeholders, and integrating a good CSR strategy. The 2004 report explicitly recommended environmental, social, and governance issues should be integrated into firms' everyday operations. What truly separates ESG from CSR, is that it is a more comprehensive term that explicitly includes corporate governance while CSR addresses governance indirectly through environmental and social considerations (Gillan et al. 2021). While CSR has traditionally been associated with a company's strategy and morals, ESG has become a quantifiable reporting framework actively used by investors and institutions (Eccles et al. 2020).

2.2 Thomson Reuters

Thomson Reuters provides one of the most complex ESG databases in the world covering over 6,000 publicly listed firms globally, with history going back to 2002 (Reuters 2017). The database is consistently updated every second week with 400 ESG matrices available in the assessment. Thomson Reuters functions as a third-party rating agency, independent from the firms it evaluates. Their neutrality is crucial in assuring that their assessments are transparent and unbiased. Their ESG calculation methodology is solely based on disclosed and publicly available information, such as annual reports. Hence, they do not collect or use data that is not disclosed or publicly available to the market. Their overall aim is to assist investors and other stakeholders in making informed and sustainable investment decisions. Figure 2.1 shows a tenfold increase in ESG covered firms in Thomson Reuters' database from 2002 to 2019 on the NASDAQ alone.

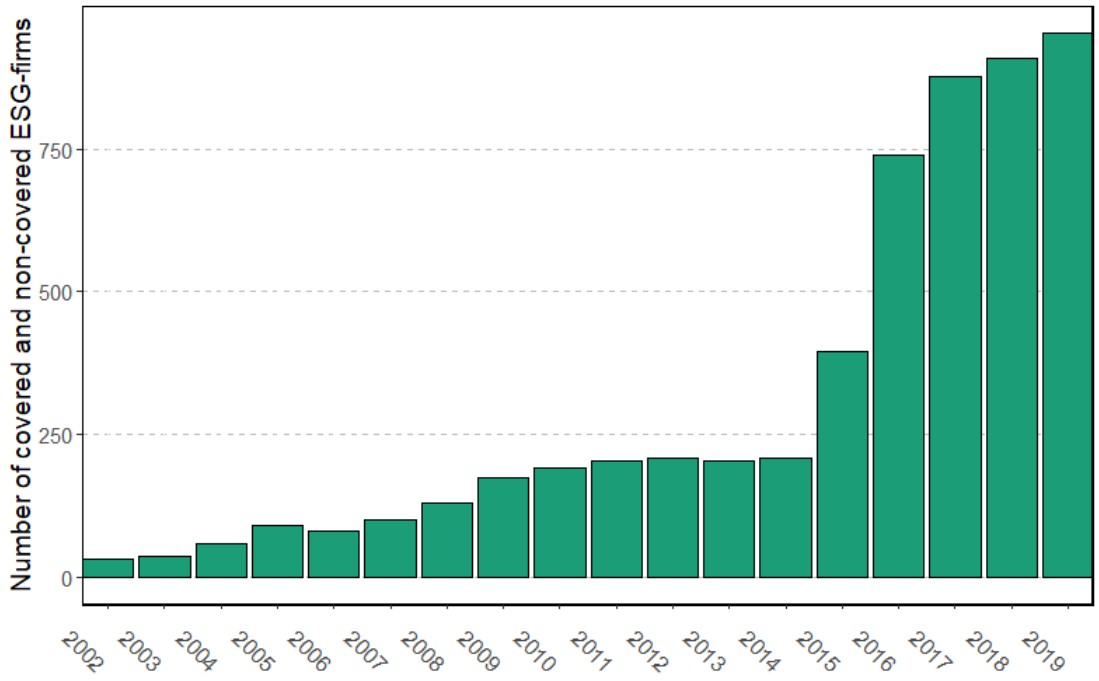

Figure 2.1: The number of firms that are included in Thomson Reuters ESG database from 2002 to 2019.

ESG scores are determined by weighting a firms' performance in each of the three pillars against that of its industry peers. Thomson Reuters' ESG score is graded on a scale of 0 to 100, with letter grades ranging from D- to A+ assigned based on the score achieved (Reuters 2017). The score for each pillar encompasses ten underlying categories that evaluate different aspects of a firm's operations, policies, and performance. Each category is weighted by number of indicators relative to total number indicators for all pillars. Number of indicators is based on the relative importance of each category in its contribution to overall ESG performance. The resulting score for each pillar is integrated into an overall ESG score for the firm. Table 2.1[6] briefly summarizes indicators and weights for each category in Thomson Reuters' calculation methodology.

Pillar	Category	Indicators in Scoring	Weights
Environmental	Resource Use	20	11%
	Emissions	22	12%
	Innovation	19	11%
Social	Workforce	29	16%
	Human Rights	8	4.50%
	Community	14	8%
	Product Responsibility	12	7%
Governance	Management	34	19%
	Shareholders	12	7%
	CSR Strategy	8	4.50%
Total		178	100%

Table 2.1: Thomson Reuters ESG calculation.

[6]Thomson Reuters ESG score categories and their individual weights can be found on page 8 at: https://www.esade.edu/itemsweb/biblioteca/bbdd/inbbdd/archivos/Thomson_Reuters_ESG_Scores.pdf

3. Literature Review

This Chapter reviews important theoretical and empirical literature regarding the relationship between ESG, stock price informativeness (SPI) and liquidity. Based on this literature, we develop arguments that this relationship is significant in the US stock market. Section 3.1 introduces modern stakeholder theory, which provides us with an understanding if it is reasonable to believe investors incorporate ESG into their investment decisions in the first place. Section 3.2 introduces the efficient market hypothesis, while section 3.3 further discusses prior literature on the relationship between ESG and SPI. Lastly, Section 3.4 ties this relationship in with the concept of liquidity.

3.1 Modern Stakeholder Theory

Modern stakeholder theory is a management framework that defines the purpose and responsibility of a firm in terms of its relationship with its stakeholders. The framework was first introduced by R. Edward Freeman in his 1984 book "Strategic Management: A Stakeholder Approach" and has become an embedded aspect of organizational decision-making (Berman et al. 1999, Mainardes et al. 2012). Stakeholder theory and ESG are closely linked, as both recognize the importance of prioritizing issues outside of the firm, such as environmental and social issues. Therefore, we utilize the principles of stakeholder theory, along with its empirical support, to argue that investors consider criteria beyond mere profit maximization while making their decisions. Consequentially, we later create arguments that stock market's response will be significant when firms disclose ESG data, and when Thomson Reuters covers them, as this will offer investors highly valuable supplementary information.

The idea of modern stakeholder theory builds on Friedman (1962). Friedman argued that the sole purpose of a firm is to maximize shareholder value. Shareholders are considered as the only group to whom the firm is socially responsible, and any action the firm takes should be in the interest of its shareholders. Unnecessary allocation of resources to other stakeholders, such as employees or local community is considered a misuse of corporate resources (Jensen & Meckling 1976). The theory, however, does acknowledge that individuals have social obligations in addition to financial ones. Friedman argued that firms fulfill their social responsibilities by providing other individuals flexibility to fulfill their own responsibilities, which is done solely through profit maximation.

Although some academics still promote this approach (Brealey et al. 2003), the theory has been widely criticized for its limited view of corporate purpose (Phillips et al. 2003, Jensen 2001).

Using a demographic approach[7] to identify stakeholder attributes (Frooman & Murrell 2005), Freeman argued that firms should actively create value for all stakeholders, not just its shareholders. By including the interest of all stakeholders into their business model, firms may experience improved financial performance and competitive strength over time. If they fail to maintain stakeholder relations, their performance may decline. Freeman considered stakeholders to be any individual who can affect or is affected by the firms' activities and objectives (Freeman 1984). Hence, indicating that the firm and its stakeholders are strongly interlinked. Therefore, the importance of modern stakeholder theory lies in its recognition that shareholder value is only maximized by considering all stakeholders over time (Freeman & Phillips 2002). Compared to the traditional shareholder theory, this offers a more comprehensive view of the purpose and responsibilities of a firm.

Using the stakeholder approach as point of departure, Frooman (1999) investigated which influence strategies stakeholders have available when trying to affect corporate behavior, and where the balance of power lies in this relationship. Frooman argued that firms operate in interactive environments, where their strategic plans must be functions of activates outside of the firm. This implies that for firms to act strategically and plan the actions they intend to take, presupposes that they have some idea of how others in their environment will act. Basing his research on resource dependent theory, he argued that the reason stakeholders are essential to firms' success, is because they can manipulate the flow of resources to the firm. Specifically, he introduced the concept of direct withholding influence strategies,[8] in which stakeholders, such as investors, can directly deprive a firm of vital resources, such as capital, if the firm does not act in line with investors' preferences. If this argument holds true, the opposite must also hold true. Hence, if ESG-coverage increases SPI, it is reasonable to argue that this can affect stock performance, such as liquidity.

There is significant empirical support for modern stakeholder theory. Ng & Rezaee (2015) argued that including sustainable accomplishments into their corporate disclosures can enhance a firm's overall reputation, social responsibilities, and environmental conduct, leading to improved long-term firm value. Furthermore, papers from Cormier et al. (2011) and Sultana et al. (2018)

[7] According to Frooman and Murrel (2005) most of the work done by stakeholder theorists favor a demographic approach, opposed to a structural approach. The demographic approach identifies key stakeholder attributes using a stakeholder map and table of demographics, such as size, locations, legitimacy and interest. The structural approach focuses on the relationships between organizations, rather than the organizations themselves. This includes stakeholder dependence, centrality within a network, and information asymmetry.

[8] Frooman (1999) developed a two-by-two topology, introducing four types of influence strategies stakeholders have available. Which strategy is optimal to choose depends on the interdependence between firm and stakeholder. In a direct withholding strategy, the dependence between the two parties is unbalanced, and stakeholder power exists. This implies that the firm is more dependent on the stakeholder, than the stakeholder is of the firm in terms of resource distribution.

indicate that firms who have insufficient stakeholder engagement strategies may face consequences, such as incurring cleanup expenses, damaging consumer trust and reduction in invested funds from investors. Furthermore, Preble (2005) reported that poor stakeholder management could lead to market share loses due to boycotts, damage to reputation and unfavorable lobbying.

There have been several studies supporting the idea of stakeholder theory, also from the perspective of empirical finance. Kempf & Osthoff (2007) were pioneers in utilizing the Fama French three-factor model to investigate the stock market's response to socially responsible investment (SRI) funds. The study examines a sample of mainly US listed firms between 1992 and 1994, using a long-short investment strategy, that involved purchasing stocks with high SRI ratings and selling stocks with low ratings. They found that high performing SRI-funds consistently have higher positive abnormal returns compared to conventual funds. Statman & Glushkov (2009) found similar results during 1992 to 2007, indicating that socially responsible investors have a return advantage relative to conventional investors. Eccles et al. (2014) also made a similar conclusion based on ESG scores.

Borgers et al. (2013) argued that high SRI rated firms' outperformance in the US stock market, was only present during the initial sampling period from the 2007 study by Kemph and Osthoff. According to Borgers et al., the positive abnormal returns were a result of the market's initial undervaluation of intangible ESG benefits. As these benefits became more tangible through increased earnings, the market corrected its valuation, resulting in abnormal returns. They suggested that if this mispricing is taking place, the earnings announcements of high ESG firms would exceed expectations. This was supported in their sample up to 2004. However, between 2004 and 2009 the mispricing disappeared, indicating that the market had correctly valued the ESG performance. Furthermore, Krüger (2015) found that investors respond weakly negatively to positive CSR announcements, while strongly negatively to negative CSR announcement. However, when positive news were associated with managerial efforts on social responsibility, the study found a positive stock market reaction, consistent with the principles of stakeholder theory.

3.2 Market Efficiency

Fama (1998) proposed that the primary purpose of capital markets is to allocate financial assets, and that market prices should ideally serve as reliable indicators for this purpose. Fama introduced the efficient market hypothesis (EMH) in 1970, which suggests that an efficient market reflects all available information in financial asset prices. According to this hypothesis, as new information arises, investors adjust their expectations accordingly. Although anomalies may occur, overvaluation and undervaluation are rare since all market participants possess the same information. The theory posits that any available information about a firm, such as financial statements, news releases, and other market indicators, is immediately reflected in its stock price. Hence, for an event

to change the stock price, it must provide the market with new information that is not already available to it.

Fama (1970) acknowledged that his efficient market model was highly strict, and therefore proposed three levels of market efficiency to easier test how efficient financial markets really are. The weak form of market efficiency states that the current market price of an asset only incorporates the historical prices and volume information. The semi-strong form of market efficiency extends the weak form by positing that the current market price of an asset also incorporates all publicly available information. Hence, any new information that becomes public will be promptly reflected in the stock price, if valued by investors. The strong form of market efficiency enhances the semi-strong form by presuming that all information, both public and private, is incorporated into the stock price. If this holds true, investors could not consistently generate abnormal returns.

The effect of ESG-coverage on SPI tests semi-strong market efficiency. Thomson Reuters only utilizes disclosed and publicly available information, thus providing supplementary data to information investors can find elsewhere, such as firms' annual reports. However, rating agencies have advanced and unbiased calculation methods, which provides investors with a professional assessment of firms ESG performance, beyond the information stated in firms' disclosure statements. Therefore, if market are assumed to be efficient in semi-strong form, we expect that this information will be incorporated into stock prices, thus increasing SPI. However, several studies (De Bondt & Thaler 1985, Lakonishok et al. 1992, Barber & Odean 2001)[9] from the field of behavior finance argue that investors are not always rational, indicating that traders do not always incorporate all available information into their speculative purpose.

Most empirical tests on semi-strong form of market efficiency have focused on major events such as announcements of stock splits, bonus issues, and dividend (Kahn & Ikram 2010). Fama et al. (1969) found that the US market's judgements concerning the information implications of a stock split are fully reflected in the stock price almost immediately after the announcement date, thus supporting that stock prices adjust very rapidly to new information. Beaver (1968) found that earnings announcements provide valuable information to traders regarding firms' future earnings and dividends, adjusting stock prices shortly after announcement. On the contrary, Jegadeesh & Titman (1993) found that momentum strategies in the US stock market, where traders buy past stock winners and sell past stock losers, generated anormal returns in the period 1965 to 1989, showing inconsistency with semi-strong market efficiency. This may indicate that not all public information is immediately incorporated into stock prices. While major events seem to adjust

[9]De Bondt and Thaler (1985) found that investors tend to be biased towards information that confirms their existing beliefs, and ignore information that contradicts those beliefs, leading to mispricing. Lakonishok et al. (1992) found that investors tend to buy stock that had recently gone up in price, due to positive rumors, and vice versa, indicating herd behavior. Barber and Odean (2001) found that individual investors tend to be overconfident in their ability to pick winning stocks, resulting in lower returns for investors with high frequency trades.

stock prices easier, compared to other public information during trading, ESG-coverage is not to be considered major, and the body of research on this topic is highly limited. Therefore, to get a better understanding on whether ESG-coverage will be valued and priced by traders, we must first consider prior research on the direct link between SPI and ESG.

3.3 Stock Price Informativeness (SPI)

According to Grossman & Stiglitz (1976), financial markets only price value relevant information. It facilitates the assimilation of a wide range of information, such as economic news, corporate announcements, and investor sentiments, into asset prices, reflecting the collective beliefs of market participants. Recent work by Ng & Rezaee (2018) defines SPI as information not reflected in common risk factors, and thus it can be considered as a measure of firm specific information which adjust stock prices. While asset pricing models consider unsystematic risk to be diversifiable and thus not priced in equilibrium, a particular research stream (Merton 1987), indicate that firm-specific information could in fact enhance SPI, as investors may use this information for their speculative purpose. Malkiel & Xu (2002) argue that this occurs because investors do not have fully diversified portfolios, while Goyal & Santa-Clara (2003) argue that this may occur because they are not heterogeneous in nature. As investors' preferences have shifted towards sustainable investing, it is reasonable to expect that all information related to ESG issues is highly value relevant for socially reasonable investors.

In the US stock market, Dasgupta et al. (2010)[10] found that firms that are more transparent and provide more information to the market will have more informative stock prices, indicated by a lower stock return synchronicity. Moreover, Haw et al. (2012) found that stronger corporate disclosures in countries with strong investors protections through effective corporate governance measures, were positively associated with SPI. Furthermore, Ferreira & Laux (2007) found that stronger corporate governance polices, represented by the absence of anti-takeover provisions, promote the gathering and trading of private information, resulting in more informative stock prices. Additionally, Plumlee et al. (2015) later found that the market's assessment of expected future cash flows are strongly influenced by voluntary environmental disclosures.

Not until recently have there been studies connecting ESG disclosures directly to SPI. Ng & Rezaee (2018) found a significantly positive correlation between non-financial ESG performance and SPI in the US stock market during 1992 – 2015. However, they found that this relationship is strongest for firms with already strong disclosure practices. Silva (2020) found similar results for several developed countries during 2007 - 2018. However, the study indicates that the relationship was strongest for firms with weak disclosure practices, contradicting the finding of Ng & Rezaee, which

[10] Dasgupta et al. (2010) argued that stock returns synchronicity increases when transparency improves. They argued that more transparency leads to less surprises about future firm-specific events, leading to more synchronic stock returns.

we believe is due to sample differences and variations across countries. Furthermore, Healy & Palepu (2001) argued that the driver behind the relation between disclosure practices and SPI, is the reduction in information asymmetry between corporations and traders. Thus, these studies indicate a positive association between information related to ESG issues and SPI.

Several studies have also criticized the role of disclosure practices in providing relevant and transparent information related to ESG policies. Michelon et al. (2015) suggested that recent ESG reporting trends have led to more disclosures, but not necessarily higher quality information. Furthermore, Birkey et al. (2017) and Dobler et al. (2015) added that firms' ESG disclosures may not be suitable for evaluating actual social and environmental policies as they may serve other purposes than objectively informing investors, such as improving corporate image. These studies indicate that although prior studies find a correlation between ESG disclosures and SPI, there still seem to be a demand for more transparent and comprehensive information. This is only provided through professional rating agencies. Hence, this additional information may be of significant value to traders. Based on prior discussion about semi-strong market efficiency in the US market, it stands to argue that ESG-ratings may in fact provide the stock market with new information which may affect SPI. This argument sets the foundation for our first hypothesis:

Hypothesis 1: *Ceteris Paribus, firms that receive their first ESG rating from a rating agency will experience an increase in SPI compared to firms that do not receive any ESG rating at all.*

3.4 Stock Liquidity

Amihud first introduced the concept of stock liquidity in 1986 (Kumar & Misra 2015). Since then, there has been ongoing efforts to define liquidity, measure it, and examine its impact on primarily asset pricing, returns, and market efficiency. Despite the theoretical and empirical literature on liquidity, there is no single, universal accepted definition on it, which can be applied to all markets. This is because liquidity has multidimensional characteristics. In early work by Rubinstein (1973), he discussed the idea behind liquidity as a securities ability to be traded without any price impact. However, one of the most acknowledged definitions of liquidity in finance to date, comes from Liu (2006), who defined liquid stocks as those that can be traded in large volumes quickly and at low cost, with minimal impact on the stock price. Accordingly, stock liquidity can be measured along four primary dimensions, (1) trading volume,[11] (2) trading speed,[12] (3) trading costs,[13] and (4) stock price impact,[14] illustrating the complexity of the concept.

[11]Trade volume refers to how much the stock can be traded at a given cost.
[12]Trading speed refers to how quickly the stock can be traded at a given cost and quantity.
[13]Trading costs refers to the expenses related to the trade of the stock at a given quantity.
[14]Stock price impact refers to how easy it is to trade the stock at a given quantity with minimum impact on price.

Previous studies highlight the significance of the informational environment and corporate disclosures regarding liquidity and its determinants (Leuz & Verrecchia 2000, Kelly & Ljungqvist 2012). The viewpoint of existing literature is that better disclosure practices and transparency decreases the level of information asymmetry in the information environment, boosting stock liquidity. Welker (1995) found that firms with low disclosure rankings have higher bid-ask spreads on average. Moreover, the study found support that that strong disclosure policies, reduces information asymmetry, which correlated positively with stock liquidity. Furthermore, Amiram et al. (2019) studied how the information environments affects liquidity, not only through asymmetric information, but also through the structure of firm-specific volatility. Their findings indicate that less transparent environments lead to more discontinuous stock prices, changing the structure of volatility. They conclude that implementing disclosure practices that promote continuous information flow to the market can decrease volatility, mitigate unexpected events, and ultimately increase liquidity. Hence, this indicates a positive association between transparency and stock liquidity.

The amount of literature directly studying the relationship between ESG and liquidity in developing markets is highly limited, particularly for the US market. However, there has been conducted studies on this relationship in emerging markets, such as the Chinese stock market, which can be applied to the US stock market. Chen, Yang, Zhang & Wang (2023) found that strong ESG disclosures enhanced stock liquidity significantly during 2001 – 2020. They argue that strong disclosures can be viewed as a positive signal to the market, increasing corporate image and reducing agency costs. Similar results were found by Chen, Liu, Jiang & Liu (2023) during 2015 – 2020. In which they argued strong disclosures enhances liquidity through a reduction in asymmetric information, in addition to increased corporate reputation. Moreover, Chung et al. (2010) found that firms with better corporate governance policies, have narrower bid-ask spreads and have less price fluctuations during trades, which again is explained through the channel of asymmetric information.

To further increase our understanding of how firm specific information, such as ESG disclosures and coverage, affects liquidity, several studies have investigated how liquidity changes during various types of firm announcements. Siikanen et al. (2017) found that corporate announcements significantly enhance stock liquidity by leaking additional information during the pre-announcement period. Similar results were found by Zhou (2006), but for stock splits specifically. Although no prior literature investigates the effect of ESG on SPI, not the effect of SPI on stock liquidity, previous studies indicate that we might expect a positive relationship between ESG, information transparency, and liquidity. Consistent with the principles of modern stakeholder theory, we argue that socially responsible investors would value ESG information from rating agencies, boosting liquidity. This argument sets the foundation for our second hypothesis:

Hypothesis 2: *Ceteris Paribus, firms that receive their first ESG rating from a rating agency will experience an increase in stock liquidity, through the channel of increased SPI.*

4. Data

The data used in this thesis focuses on the NASDAQ Global Stock Exchange, and was collected from Thomson Reuters during February 2023. Section 5.1 presents the dependent-, independent- and control variables in our dataset. Section 5.2 describes the data cleaning process while Section 5.3 summarizes the final dataset which is used in our models.

4.1 Variable Selection

4.1.1 Dependent Variables

As we hypothesize that firms that get ESG-covered, provide new information to the market, the key to our empirical analysis is to quantify how stock prices contain such information. As a measure for SPI, we use price nonsynchronicity. This measure was first proposed by (Roll 1988) and further developed by (Morck et al. 2000) and (Durnev et al. 2004). It is computed on the basis of the correlation between the stock's return, the return of its respective industry and the return of the market. However, the interpretation of the correlation between these factors are up for debate. According to Morck et al. (2000), Durnev et al. (2004), firms with higher correlation tend to have less firm-specific information incorporated into their stock prices, leading to less informative prices for firms. However, Kelly (2005) and Dasgupta et al. (2010) contend that a rapid incorporation of information into stock prices can reduce idiosyncratic return volatility, indicating that higher correlation reflects a higher level of SPI. Meanwhile, Chan et al. (2013) find that there is a positive relationship between price nonsynchronicity and liquidity, suggesting that stocks with less firm-specific information face less information asymmetry.

Having considered the arguments put forth by the authors, this thesis will focus on the interpretation offered by Kelly (2005). The intuition is that if a firm's stock return is highly correlated with the market and the industry, then the firm's stock price is less likely to contain private information and thus generate a lower value of price nonsynchronicity, improving SPI. On the contrary, if the stock return is less correlated with the market and the industry, it will increase price nonsynchronicity, leading to a reduction in SPI.

When we analyze the variation of a stock's return, we can break it down into three distinct components. The first two components, which are related to the market and industry, are systematic variations that affect multiple firms. The third component, on the other hand, is unique to each firm and captures firm-specific variation or price nonsynchronicity. In simpler terms, we can think of these components as different sources of variation that contribute to a stock's containment of information. It can be estimated by $1 - R^2$ where R^2 is the R-square from the following regression:

$$r_{i,t} = \beta_{i,0} + \beta_{i,m} r_{m,t} + \beta_{i,j} r_{j,t} + \epsilon_{i,t} \tag{4.1}$$

where $r_{i,t}$ is the return of firm i in industry j at time t, $r_{m,t}$ is the market return m at time t, and $r_{j,t}$ the return of industry j at time t. As a measure for market return, we use daily average returns from NASDAQ as well as GICS classifications to measure industry returns. Price nonsynchronicity for firm i in year t is estimated individually for each firm. For the remainder of this thesis, price nonsynchronicity will be displayed as SPI, where a higher value of this measure will be interpreted as more information displayed to the market and vice versa.

In accordance with previous research (Johnson 2010), we use relative bid-ask spread (BAS) as a measure for stock liquidity to quantify the effect of ESG-coverage on liquidity, through the channel of SPI. The relative bid-ask spread is a commonly used metric in financial markets to assess liquidity. It is given by the following formula:

$$BAS_{i,t} = \frac{ASK_{i,t} - BID_{i,t}}{\left(\frac{ASK_{i,t} - BID_{i,t}}{2}\right)} \tag{4.2}$$

where $BAS_{i,t}$ is the relative bid-ask spread for firm i at time t, $ASK_{i,t}$ is the lowest price at which sellers are willing to sell a security and $BID_{i,t}$ is the highest price at which buyers are willing to buy a security. By calculating the difference between the ask price and the bid price and normalizing it by dividing by half of the same difference, we obtain a measure of the relative bid-ask spread. This measure provides a normalized spread value that can be used to compare the bid-ask spreads of different firms, regardless of their absolute price levels. It helps to assess the cost of trading and market efficiency, where a higher relative bid-ask spread indicates lower liquidity and potentially higher trading costs. Therefore it is considered a highly useful for measuring liquidity. Additionally, it is relatively easy to calculate and widely available for most stocks.

A wide bid-ask spread implies that investors may incur higher transaction costs and reduced returns while buying or selling a security Ho & Stoll (2002). Conversely, a narrow bid-ask spread indicates that investors can buy and sell securities at a lower cost, thereby improving their returns and lowering their transaction costs. Another way to interpret the relative bid-ask spread is to consider it as a demand function. A smaller bid-ask spread indicates a higher demand for the stock, while a wider spread indicates lower demand. For the upcoming sections, the relative

bid-ask spread will be defined as LIQ_BAS, where higher values of this measurement will indicate an improvement in stock liquidity and vice versa.

We apply an additional measure for stock liquidity to ensure that our results are robust to the different proxies. We use the Amihud (2002) measure of illiquidity. The illiquidity ratio measures the price impact of trading securities and is one of the most widely used proxies for stock liquidity Amihud (2002). The ratio for firm j at time t of month m is computed by dividing the absolute return $|r_{jtm}|$ by the corresponding volume traded in USD, $Volume_{jtm}$, and then averaging over the D_{jmt} trading days in the year:

$$AIR_{jt} = \frac{1}{D_{jm}} \sum_{t=1}^{D_{jmt}} \frac{|r_{jtm}|}{Volume_{jtm}} \tag{4.3}$$

This ratio shows how the price responds for each USD of transaction. A high value of this ratio means that the stock price is sensitive to small trading volumes, indicating illiquidity, whereas a low value of the ratio indicates a more liquid asset. For the upcoming sections, the Amihud illiquidity ratio will be defined as LIQ_AIR, where higher values of this measurement will indicate an improvement in stock liquidity.

4.1.2 Independent Variables

Our main variable of interest is ESG-coverage (ESG). As specified earlier, the ESG variable is defined as a binary variable, indicating if a firm has received an ESG score or not. Figure 4.1 shows an illustrating time-series for the amount of first-time ESG-covered firms and non-covered firms for each respective year in the period 2002 - 2019. We see that the amount of ESG-covered firms remain relatively low until the mid-2010s. This makes sense, as ESG reporting became more recently widely adopted by firms around the world, as regulatory bodies and investors began to recognize its importance in assessing a firm's long-term sustainability and financial performance (Stanley 2017).

To account potential biases in our models, we employ a set of control variables. First, we control for $SIZE$ as larger firms tend to show more information transparency with regards to their operations and policies (Rajan & Servaes (1995). Further, we account for market-to-book ratio (MTB) as investors who have access to better information are more likely to invest in more transparent firms Garmaise & Moskowitz (2005). Additionally, to effectively manage long-term liabilities and payables, we consider the impact of cash flow (CF) and leverage (LEV) (Cullinan & Myers (2010). Lastly, the firm's profitability is accounted for as return on assets (ROA).

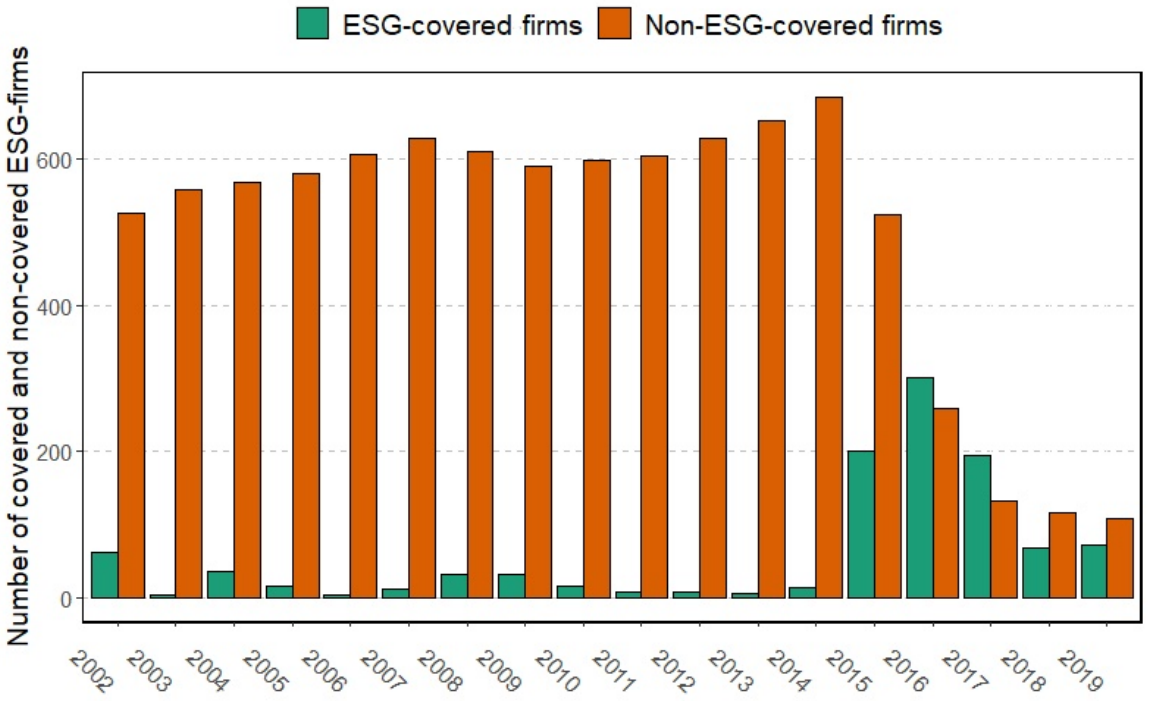

Figure 4.1: The number of first-time ESG-covered and non-ESG-covered firms from 2002 - 2019

4.2 Data Cleaning

As Thomson Reuters started reporting ESG-scores back in 2002, we restrict the dataset to the period between 1st of January 2002 to 31st of December 2019. The advantage of using Thomson Reuters is that these ratings were provided several years before other rating providers entered the market. Therefore, it is very likely that the Thomson Reuters ESG rating is the first ESG rating a US firm received. Thus, the results of this thesis are not biased by the earlier receipt of an ESG rating from a further rating provider. However, according to Smith & Johnson (2021), the growing demand for ESG data and analysis among investors, firms, and other stakeholders has led to a significant increase in the number of rating agencies performing ESG ratings on newer firms. Therefore, it is not likely that Thomson Reuters ESG ratings are the first to have performed ESG ratings on such firms. Furthermore, we still believe that Thomson Reuters ESG scores are relevant for our thesis as Thomson Reuters is considered the most comprehensive and widely-used data source for ESG ratings (Smith et al. 2020).

Further, we use firm-year observations for our analysis. There are several reasons behind this. First, daily stock returns can be quite volatile and influenced by short-term factors such as news events, market fluctuations, and trading volume. To get a more stable measure of a firm's performance over time, we have aggregated daily data into firm-year observations. This way, we can reduce some of the noise in the data and obtain a clearer picture of a firm's long-term performance. Second, when assessing a firms' performance, it is typically evaluated based on the firm's policies,

practices, and impact over the long-term. By aggregating daily data to firm-year observations, we can get a better reflection of a firm's long-term impact on our main variables of interest. Lastly, many of our variables are only available on a year-to-year basis, which makes using firm-year observations a more practical and viable approach. Overall, using firm-year observations can provide us with a more accurate and comprehensive analysis of a firm's performance and impact over time.

We also use yearly averages of stock data such as stock returns and relative closing bid-ask spreads for each firm as we use firm-year observations for our analysis. Subsequently, we remove missing observations that do not include completed row values. We then discard observations with negative or exceedingly values in firm size. We also remove observations with infinite liquidity and negative bid-ask spreads that are likely caused by low volume days. Finally, we winsorize all variables at the 95% level to reduce the impact of outliers. The final dataset consists of 1043 unique firms and 12,704 firm-year observations. All variables used in the dataset are explained in detail in Appendix A.1.

4.3 Final Dataset

Our final dataset consists of 1,043 unique firms and 12,704 firm-year observations. Descriptive statistics are presented in Table 4.1 while Table 4.3 shows the correlations between all the variables. It shows that both liquidity measurements LIQ_BAS and LIQ_AIR are positively correlated with SPI with a correlation coefficient of 0.126 and 0.396, respectively. This indicates that when SPI increases (higher value), stock liquidity also tends to increase (higher value). Even though we can not draw causal conclusions based on these statistics, it makes up for an interesting analysis in the upcoming sections.

Table 4.1: Descriptive statistics

This table presents descriptive statistics for the variables used in this thesis, winsorized at the 95% level, covering the period 2002-2019. SPI is measured as price nonsynchronicity, while LIQ_BAS is measured as the relative bid-ask spread and LIQ_AIR is measured as the log-transformed Amihud illiquidity ratio. Returns (RET), return on assets (ROA), and leverage (LEV) are expressed as percentages in decimals, while cash flow (CF) is reported in USD millions. Market capitalization (MCAP) and firm size (SIZE) are shown as log-transformed values. For further information regarding the variables, refer to Table A.1 in the Appendix.

	N	MEAN	SD	MIN	MAX	Pctl(25)	Pctl(75)
SPI	12,704	0.681	0.176	0.307	0.980	0.558	0.815
LIQ_BAS	12,704	0.049	0.222	-0.284	2.000	0.001	0.006
LIQ_AIR	12,704	-21.746	2.481	-26.918	-16.656	-23.495	-19.997
RET	12,704	0.001	0.003	-0.006	0.010	-0.001	0.003
ROA	12,704	0.018	0.130	-0.462	0.232	0.005	0.083
CF	12,704	366.370	1,439.337	-646.757	14,514.160	11.367	150.498
MCAP	12,704	0.830	0.783	-0.686	2.735	0.274	1.319
SIZE	12,704	6.350	1.545	3.540	10.148	5.261	7.236
LEV	12,704	0.249	0.242	0	0.822	0.003	0.429

Table 4.2: Pearson correlation matrix for all variables.

This table shows the Pearson correlation matrix for all variables used in this thesis. The correlation matrix indicates the strength and direction of linear relationships between each pair of variables. For further explanation of the variables, see Table A.1 in the Appendix

	SPI	LIQ_BAS	LIQ_AIR	RET	ROA	CF	MCAP	SIZE	LEV
SPI									
LIQ_BAS	0.126								
LIQ_AIR	0.396	0.159							
RET	0.114	-0.009	0.183						
ROA	-0.078	-0.046	-0.217	0.057					
CF	-0.075	-0.024	-0.371	-0.014	0.178				
MCAP	0.027	-0.077	-0.331	0.259	0.055	0.111			
SIZE	-0.391	-0.065	-0.691	-0.097	0.219	0.497	-0.026		
LEV	-0.066	0.036	-0.069	-0.048	-0.044	0.089	-0.001	0.394	

5. Methodology

This Chapter reviews the literature supporting the framework and models used to investigate the relationship between ESG-coverage, SPI, and stock liquidity. It is divided into two sections outlining the methodology applied in this thesis. Section 5.1 provides an overview of the model used to test our hypotheses, while Section 5.2 demonstrates the application of two-stage analysis to determine if increased SPI is a channel through in which ESG-coverage increases stock liquidity.

5.1 Model Definition

5.1.1 Implicit Difference-in-Differences

Difference-in-difference (DiD) is a quasi-experimental design that is used to estimate the causal effect of a treatment or policy change on an outcome variable (Angrist & Pischke (2009). The model compares the changes in the outcome variable over time between the treatment group and the control group. The DiD model is useful in situations where a randomized controlled trial is not possible, such as when the treatment is already in place. Additionally, DiD relaxes the independence assumption under OLS by allowing for unobserved, constant over time differences in outcomes between treated and untreated firms.

As firms that get first-time ESG-coverage vary from year to year, the treatment effect would also vary. When using a single-year DiD estimator, the assumption is that any differences in the outcome between the treatment and control groups in the post-treatment period are solely due to the treatment. However, if there are other factors that affect the outcome in both groups, such as a sudden economic downturn, then the DiD estimator may not fully account for these confounding factors. Instead, we apply implicit difference-in-difference (iDiD), also known as panel model with two-way fixed effects. IDiD is a variant of the traditional DiD which helps us address these potential biases. The application of this method relies on the parallel trend assumption, meaning that in the absence of a treatment, the treated group and control group should have similar trends (Caliendo & Kopeinig (2008). We state that stacked DiD is also an alternative option to test our hypotheses, as both models are commonly used in practise and share similarities (Cameron & Trivedi (2009).

5.2 Two-Stage Analysis

To test **Hypothesis 1**: *"Ceteris Paribus, firms that receive their first ESG rating from a rating agency will experience an increase in SPI compared to firms that do not receive any ESG rating at all"*, we estimate the following iDiD regression model:

$$SPI_{i,t} = \beta_1 ESG_i + \gamma X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t} \tag{5.1}$$

where $SPI_{i,t}$ is the stock price informativeness of firm i in year t. ESG_i is a binary variable that equals one if firm i has been ESG-covered by TR and zero otherwise, and $X_{i,t}$ is a vector of control variables. The error term $\epsilon_{i,t}$ captures unobserved factors influencing the dependent variable. To account for unobserved time-invariant differences across companies, such as country, industry, listings, and management, we incorporate μ_i as the firm-fixed effects. Similarly, to capture unobserved differences across time, we include λ_t as the time-fixed effects. This common panel data modeling technique in financial literature addresses firm- and time-variant heterogeneity in the panel data sample (Flannery & Hankins (2013). An overview of the first hypothesis is illustrated in Figure 5.1 in which we test the direct relationship between first-time ESG-coverage and SPI.

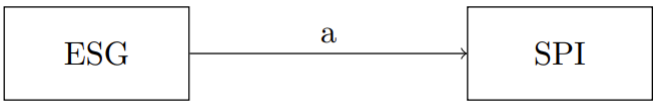

Figure 5.1: The role of ESG-coverage (ESG) on stock price informativeness (SPI)

If β_1 from Equation (5.1) is significant and greater than zero, we conclude that being ESG-covered compared to not being ESG-covered, improves SPI. Thus, we can test **Hypothesis 2**: *"Ceteris Paribus, firms that receive their first ESG rating from a rating agency will experience an increase in stock liquidity, through the channel of increased SPI".*

First, the dependent variable LIQ is regressed on the independent variable ESG to see if there exists a relationship between ESG-coverage and stock liquidity. We estimate the following regression:

$$LIQ_{i,t} = \beta_2 ESG_i + \gamma X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t} \tag{5.2}$$

where LIQ is the measure of stock liquidity for firm i in year t. If β_2 is significant and greater than zero, we conclude that being ESG-covered compared to not being ESG-covered, improves stock liquidity. The next step is to quantify how much of the effect that is due to increased SPI. Therefore, the first stage is to use fitted values from our model in Equation (5.1):

$$\hat{SPI}_{i,t} = \beta_1 ESG_i + \gamma X_{i,t} + \mu_i + \lambda_t \tag{5.3}$$

where $\hat{SPI}_{i,t}$ are the fitted values measure of SPI for firm i in year t. Finally, the dependent variable LIQ is regressed on $\hat{SPI}_{i,t}$, given by the regression:

$$LIQ_{i,t} = \beta_3 \hat{SPI}_{i,t} + \gamma X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t} \tag{5.4}$$

If β_3 is significant, there exists a relationship between ESG-coverage and stock liquidity through the channel of improved SPI. More specifically, if β_3 is positive, SPI improves stock liquidity through ESG-coverage. On the other hand, if β_3 is negative, SPI worsens stock liquidity through ESG-coverage. The more close β_3 is in absolute value compared to β_1 in Equation (5.2), the more of the variation it tends to capture from ESG-coverage on stock liquidity. The size of the coefficients between β_1 and β_3 gives us an idea about how much the influence of ESG-coverage on stock liquidity actually goes through SPI. An overview of the analysis is illustrated in Figure 5.2. Path 'a' shows path in which we test our first hypothesis, investigating the relationship between ESG-coverage and SPI, while path 'ab' and 'c' shows our approach for our second hypothesis. Hence, we quantify the effect of SPI on the relationship between ESG-coverage and liquidity using a two-stage analysis.

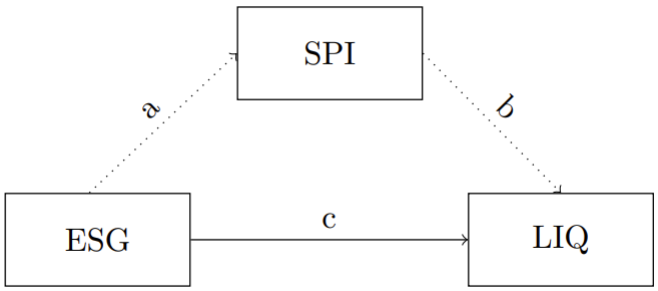

Figure 5.2: The role of stock price informativeness (SPI) in the relationship between ESG-coverage (ESG) and stock liquidity (LIQ)

6. Results and Discussion

This Chapter presents the results from the methodology section. Section 6.1 presents empirical evidence on the relationship between first-time ESG-coverage and SPI. Section 6.2 investigates the direct relationship between first-time ESG-coverage and stock liquidity. Section 6.3 presents the results from our two-stage analysis, where we investigate if improved SPI leads to improved stock liquidity. Lastly, 6.4 presents various robustness checks to validate our results.

6.1 Relationship Between First-Time ESG Rating and SPI

We investigate the relationship between ESG-coverage and SPI by estimating the two-way fixed effects panel regression in Equation (5.1). Table 6.1 displays the results from the regression. Columns (1) - (4) shows the step-by-step comparison for the relationship between ESG-coverage and SPI, while column (5) shows the completed iDiD model, containing all the steps from columns (1) - (4). The results show that ESG-coverage is positively associated with SPI and that this effect is statistically significant at the 0.1% level. The estimated main coefficient of interest for column (1) is 0.071, while for column (5) it is 0.029, indicating that on average, firms that do get ESG-covered show better measures of SPI compared to the ones that do not get such coverage. We see that with the inclusion of control variables and and both time- and firm fixed effects, the effect gets significantly reduced to 0.029 decimal points in column (5), indicating that there are other explanatory factors that have an effect on SPI as well.

As interpreting a coefficient of 0.029 independently can be difficult, we can compare this to the mean value of our dependent variable SPI in Table 4.1, which shows a value of 0.681. Interpreting this coefficient in terms of percentages would then indicate that firms that do get ESG-covered, provide approximately 4.3 percentage points $((\frac{0.029}{0.681}) \times 100)$ better information to the market compared to the ones that do not get ESG-covered. Additionally, interpreting these findings in comparison to the standard error of the variable shows a resulting ratio of 16.5% $(\frac{0.035}{0.222})$. This suggests that the impact of ESG-coverage on SPI, as indicated by the coefficient in the last column, is modest in magnitude relative to the inherent variability in SPI. With regards to the control variables, we find that RET, ROA, CF and LEV and $MCAP$ are positively associated with SPI while $MCAP$ and $SIZE$ affects are negatively associated with SPI.

Our results are consistent with our first hypothesis, indicating that ESG-covered firms show better SPI compared to non-ESG-covered firms. We believe the intuition behind this relationship is that typical investors do not have the time nor the resources to performed comprehensive evaluations of firms' own ESG disclosures (Marhfor et al. 2013), creating a demand for professional rating agencies to evaluate disclosures and practises for them. Rating agencies have comprehensive rating methodologies, that provides investors with more thorough assessments then investors can do themselves. This is particularly relevant for firms with poor disclosure practises, as discussed by Birkey et al. (2017) and Dobler et al. (2015). Consistent with previous literature, it stands to reason that rating agencies may reduce information asymmetry in the US stock market, providing value relevant information to socially responsible investors. This argument is consistent with the notion than more investors' preferences shift towards sustainable investing, making this information increasingly more demanded. However, these explanatory mechanisms in the relationship between ESG-coverage and SPI is beyond the scope of this thesis.

6.2 Relationship Between First-Time ESG Rating and Liquidity

In this section, we investigate the relationship between ESG-coverage and stock liquidity as our baseline before we test our second hypothesis. Columns (1) to (4) in Table 6.2 show the results from estimating Equation (5.2). Column (1) includes no control variables while column (2) includes all control variables, using the relative bid-ask spread as a measurement for stock liquidity. Similarly, column (3) includes no control variables while column (4) includes all control variables, using the log-transformed Amihud illiquidity ratio as a second measure for stock liquidity. The main columns of interest are (2) and (4). Both columns show that ESG-coverage is positively associated with stock liquidity, and that the effect is significant at the 0.1% level. More specifically, the results show that on average, ESG-covered firms, compared to the firms that are not ESG-covered, show increased stock liquidity by 0.035 decimal points or 3.5 percentage points (0.035×100) for column (2) and 0.153 in decimal points, or 16.5 percentage points ($\epsilon^{0.153} - 1) \times 100$) for column (4).

To put our findings in a context, we can compare them to the standard errors of our dependent variables LIQ_BAS and LIQ_AIR, shown in Table 4.1. For the relative bid-ask spread (LIQ_BAS), the mean is 0.049 with a standard deviation of 0.222. The estimated increase in stock liquidity associated with ESG-coverage is 0.035, which is approximately 16% of the standard deviation ($\frac{0.035}{0.222}$). This suggests that the effect of ESG-coverage on the relative bid-ask spread is relatively large, representing a meaningful difference in stock liquidity. For the log-transformed Amihud illiquidity ratio (LIQ_AIR), the mean is -21.746 with a standard deviation of 2.481.

Table 6.1: Association between ESG-coverage and SPI.

This table reports the relationship between ESG-coverage and SPI using an implicit difference-in-differences model. SPI is measured by the price nonsynchronicity. Columns (1) and (2) present standard OLS regressions without controls and with all controls, respectively. Columns (3) and (4) show OLS regressions with firm fixed effects and time fixed effects, respectively. Column (5) represents an iDiD regression with controls, firm fixed effects, and time fixed effects. Standard errors are reported in parentheses, clustered by firm.

	Dependent variable:				
	SPI				
	(1)	(2)	(3)	(4)	(5)
ESG	0.071***	-0.037***	-0.005	-0.034***	0.029***
	(0.006)	(0.005)	(0.005)	(0.007)	(0.005)
RET		4.517***	3.743***	2.690***	2.359***
		(0.398)	(0.356)	(0.438)	(0.366)
ROA		0.023	0.017	0.022	0.053***
		(0.015)	(0.019)	(0.015)	(0.017)
CF		0.00002***	0.00001***	0.00002***	0.00001***
		(0.00000)	(0.00000)	(0.00000)	(0.00000)
MCAP		−0.012***	−0.014***	−0.020***	−0.043***
		(0.004)	(0.004)	(0.004)	(0.004)
SIZE		−0.068***	−0.069***	−0.067***	−0.057***
		(0.003)	(0.004)	(0.003)	(0.004)
LEV		0.107***	0.127***	0.101***	0.133***
		(0.013)	(0.014)	(0.013)	(0.013)
Constant	0.708***	1.069***			
	(0.005)	(0.018)			
Observations	12704	12704	12704	12704	12704
Model	OLS	OLS	Firm FE	Time FE	iDiD
Firm FE	No	No	Yes	No	Yes
Year FE	No	No	No	Yes	Yes
Cluster SE	By firm	By firm	By firm	By firm	By firm
Adjusted R^2	0.038	0.197	0.024	0.203	−0.011
F Statistic	501.356***	445.229***	192.211***	442.974***	131.074***

Note: *p<0.1; **p<0.05; ***p<0.01

The estimated increase in stock liquidity associated with ESG-coverage is 0.153, which is approximately 6% of the standard deviation ($\frac{-21.746}{2.481}$). Although the percentage increase is smaller compared to the relative bid-ask spread, it is important to note that the Amihud illiquidity ratio is already on a logarithmic scale, which can influence the interpretation of the effect size.

In practical terms, a significant 3.8 percentage point and a 16.5 percentage point increase in different measures of stock liquidity for ESG-covered firms is a meaningful difference, as it suggests that investors are more willing to trade shares of ESG-covered firms. This could be due to several reasons, such as the perception that ESG-covered firms are more socially responsible and may have lower risk profiles, leading to increased investor demand for their shares. Moreover, we find that RET, CF and LEV negatively affects stock liquidity while ROA and $MCAP$ positively affects stock liquidity. By controlling for these factors, the estimated effect of ESG-coverage on stock liquidity is likely more accurate and reliable.

Our results are consistent with the idea that ESG factors are becoming more important to investors, and firms that receive ESG-coverage may be more attractive to investors, leading to increased demand for their shares and thus generating better liquidity in the market. Additionally, it is possible that firms with strong ESG ratings are better managed and have lower risk, leading to greater investor confidence and a higher demand for their shares. Moreover, Amirian et al. (2019) suggested that implementing disclosure practices that promote continuous information flow to the market can decrease volatility, mitigate unexpected events. Hence, investors may use first-time ESG ratings, as predictors of firms risk profiles, ultimately affecting liquidity.

Table 6.2: Association between ESG-coverage and stock liquidity.

This table reports the relationship between ESG-coverage and stock liquidity by using implicit difference-in-differences model. Columns (1) and (2) show the regression based on the first measurement of stock liquidity, the relative bid-ask spread (LIQ_BAS). Further, columns (3) and (4) show the second measurement of stock liquidity, the log-transformed Amihud illiquidity ratio (LIQ_AIR). Standard errors are reported in parantheses, clustered by firm.

	Dependent variable:			
	LIQ_BAS		LIQ_AIR	
	(1)	(2)	(3)	(4)
ESG	0.023***	0.035***	0.672***	0.153***
	(0.007)	(0.008)	(0.063)	(0.050)
RET		2.218***		154.683***
		(0.744)		(4.545)
ROA		−0.037		−1.348***
		(0.038)		(0.167)
CF		0.00001***		0.00002
		(0.00000)		(0.00002)
MCAP		−0.032***		−0.972***
		(0.008)		(0.038)
SIZE		−0.018***		−1.213***
		(0.007)		(0.039)
LEV		0.027		1.979***
		(0.023)		(0.115)
Observations	12704	12704	12704	12704
Model	iDiD	iDiD	iDiD	iDiD
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster SE	By firm	By firm	By firm	By firm
Adjusted R^2	−0.089	−0.081	−0.071	0.263
F Statistic	11.629***	14.012***	198.513***	798.258***

Note: *p<0.1; **p<0.05; ***p<0.01

6.3 Relationship Between First-Time ESG Rating, SPI and Liquidity

In this section, we perform a two-stage analysis to investigate if increased SPI is a channel through in which ESG-coverage increases stock liquidity. As described in Section 5.2, the first step is to generate fitted values from Equation (5.3). The second step is to use these fitted values as an independent variable to determine whether there is a significant association between the fitted variable ($\hat{SPI}$) and stock liquidity (LIQ). Table 6.3 presents the results from estimating Equation (5.4) where two measures of stock liquidity are regressed on the fitted values from (5.3). The results show no statistical evidence that increased SPI is a channel through in which ESG-coverage increases stock liquidity.

A potential interpretation is that the increase in SPI of ESG-coverage is not detectable in the full sample, as firms that receive higher ESG scores, the effect on stock prices and liquidity may not be uniform across all firms. In other words, the impact of ESG-coverage on stock prices and liquidity may be dependent on other factors that vary across firms, such as industry sector, company size, and governance structure. Additionally, it is also possible that the relationship between ESG-coverage, SPI, and stock liquidity is more complex. For instance, it could be that the impact of ESG-coverage on stock liquidity is not mediated solely by increased SPI, but rather through other channels. For instance, changes in stakeholder pressure, or corporate reputation. Additionally, it can be argued that ESG ratings themselves may serve as a form of marketing for firms, raising awareness among investors and potentially leading to increased liquidity for those firms.

To further investigate these possibilities, future research could explore the influence of industry sector, company size, and governance structure as potential moderating factors. Additionally, analyzing the impact of ESG-coverage on stock liquidity through the lens of investor awareness, stakeholder dynamics, and corporate reputation could provide deeper insights into the complex relationship between these variables. It is important to note that these interpretations should be made cautiously, considering the limitations of the analysis and the specific context of the study.

Table 6.3: Moderating effect of SPI on the relationship between ESG-coverage and stock liquidity.

This table reports the relationship between ESG-coverage, SPI and stock liquidity by using implicit difference-in-differences model. The fitted values of SPI ($\hat{SPI}$) are used on two liquidity measures; the relative bid-ask spread (LIQ_BAS) and the log-transformed Amihud illiquidity ratio (LIQ_AIR). Standard errors are reported in parentheses, clustered by firm.

	Dependent variable:	
	LIQ_BAS	LIQ_AIR
	(1)	(2)
$\hat{SPI}$	0.355	1.765
	(1.218)	(1.377)
RET	2.218***	154.683***
	(0.636)	(3.752)
ROA	−0.037	−1.348***
	(0.024)	(0.140)
CF	0.00001***	0.00002
	(0.00000)	(0.00002)
MCAP	−0.032***	−0.972***
	(0.004)	(0.025)
SIZE	−0.018***	−1.213***
	(0.004)	(0.024)
LEV	0.027**	1.979***
	(0.014)	(0.081)
Observations	12704	12704
Model	iDiD	iDiD
Firm FE	yes	yes
Year FE	yes	yes
Cluster SE	by firm	by firm
Adjusted R^2	−0.081	0.263

Note: *p<0.1; **p<0.05; ***p<0.01

6.4 Robustness Checks

To test the robustness of our findings, we perform a sub-sample analysis that examines different time periods. Specifically, we divide the data set into two distinct periods: 2002-2009 and 2010-2019. The results of Equation (5.1), (5.2), and (5.4) for both periods are presented in Table 6.4 and Table 6.5, with each showing the use of different liquidity measures. Our analysis shows that the positive relationship between ESG-coverage and both SPI and stock liquidity is statistically significant regardless of the time period. Notably, we find no evidence of a relationship between increased SPI and stock liquidity through ESG-coverage for either of the tables. Moreover, our results reveal that the impact of ESG-coverage on SPI and stock liquidity tends be higher in the first sub-period compared to the second sub-period. Overall, our sub-sample analysis further supports the robustness of our findings and indicates that the impact of initial ESG-coverage on SPI and liquidity has changed over the years.

Further, we use various winsorization levels to check how our models responds to different boundaries. Table 6.6 shows the results of winsorizing the data set at the 99% level, giving less room for outliers. We find that there is a statistically significance for ESG-coverage on both SPI and stock liquidity, but no significance for the role of SPI in the relationship between ESG-coverage and stock liquidity. We also winsorize the data set to 90%, making a larger portion of the data unaffected and thus giving room for more outliers. The results are displayed in Table 6.7. Interestingly, even though the effect of the outliers are seemingly higher, we find similar results to 99% winsorization, making our results robust to different winsorization levels.

Table 6.4: Association between ESG-coverage, SPI and stock liquidity for different sub-samples using the relative bid-ask spread (LIQ_BAS) as a measurement for stock liquidity.

This table reports the relationship between ESG-coverage, SPI and stock liquidity by using implicit difference-in-differences model. Columns (1) - (3) are show the relationship for the first period 2002-2009 while columns (4) - (6) show the relationship for the second period 2010-2019. Standard errors are reported in parentheses, clustered by firm.

	2002-2009			*2010-2019*		
	SPI	LIQ_BAS	LIQ_BAS	SPI	LIQ_BAS	LIQ_BAS
	(1)	(2)	(3)	(4)	(5)	(6)
ESG	0.064***	0.091***		0.028***	0.015***	
	(0.018)	(0.026)		(0.005)	(0.002)	
$\hat{SPI}$			0.281			0.049
			(0.373)			(0.033)
RET	3.760***	−1.161	−1.161	4.648***	0.924*	0.924*
	(0.528)	(1.309)	(1.309)	(0.626)	(0.552)	(0.552)
ROA	0.037	−0.083	−0.083	−0.065**	−0.008	−0.008
	(0.025)	(0.056)	(0.056)	(0.025)	(0.008)	(0.008)
CF	0.00003***	0.00002***	0.00002***	0.00002***	0.00000	0.00000
	(0.00001)	(0.00001)	(0.00001)	(0.00000)	(0.00000)	(0.00000)
MCAP	−0.020***	−0.046***	−0.046***	−0.003	−0.008***	−0.008***
	(0.005)	(0.010)	(0.010)	(0.005)	(0.003)	(0.003)
SIZE	−0.082***	−0.043***	−0.043***	−0.049***	−0.0004	−0.0004
	(0.005)	(0.009)	(0.009)	(0.004)	(0.001)	(0.001)
LEV	0.078***	0.131***	0.131***	0.102***	−0.005	−0.005
	(0.021)	(0.039)	(0.039)	(0.017)	(0.008)	(0.008)
Observations	5052	5052	5052	7652	7652	7652
Model	iDiD	iDiD	iDiD	iDiD	iDiD	iDiD
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	By firm	By firm	By firm	By firm	By firm	By firm
Adjusted R^2	0.166	−0.065	−0.065	0.016	−0.086	−0.086

Note: *p<0.1; **p<0.05; ***p<0.01

Table 6.5: Association between ESG-coverage, SPI and stock liquidity for different sub-samples using the log-transformed Amihud illiquidity ratio (LIQ_AIR) as a measurement for stock liquidity.

This table reports the relationship between ESG-coverage, SPI and stock liquidity by using implicit difference-in-differences model. Columns (1) - (3) show the relationship for the first period 2002-2009 while columns (4)- (6) show the relationship for the second period 2010-2019. Standard errors are reported in parentheses, clustered by firm.

	2002-2009			*2010-2019*		
	SPI	LIQ_AIR	LIQ_AIR	SPI	LIQ_AIR	LIQ_AIR
	(1)	(2)	(3)	(4)	(5)	(6)
ESG	0.064***	0.346***		0.028***	0.179***	
	(0.018)	(0.123)		(0.005)	(0.048)	
$\hat{SPI}$			-2.727			2.532
			(1.740)			(1.954)
RET	3.760***	153.002***	153.002***	4.648***	189.416***	189.416***
	(0.528)	(5.506)	(5.506)	(0.626)	(7.119)	(7.119)
ROA	0.037	−1.241***	−1.241***	−0.065**	−0.668***	−0.668***
	(0.025)	(0.240)	(0.240)	(0.025)	(0.186)	(0.186)
CF	0.00003***	0.0002***	0.0002***	0.00002***	0.00004*	0.00004*
	(0.00001)	(0.00004)	(0.00004)	(0.00000)	(0.00002)	(0.00002)
MCAP	−0.020***	−1.322***	−1.322***	−0.003	−1.170***	−1.170***
	(0.005)	(0.045)	(0.045)	(0.005)	(0.041)	(0.041)
SIZE	−0.082***	−1.427***	−1.427***	−0.049***	−1.177***	−1.177***
	(0.005)	(0.037)	(0.037)	(0.004)	(0.031)	(0.031)
LEV	0.078***	2.936***	2.936***	0.102***	2.117***	2.117***
	(0.021)	(0.164)	(0.164)	(0.017)	(0.128)	(0.128)
Observations	5052	5052	5052	7652	7652	7652
Model	iDiD	iDiD	iDiD	iDiD	iDiD	iDiD
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	By firm	By firm	By firm	By firm	By firm	By firm
Adjusted R^2	0.166	0.633	0.633	0.016	0.571	0.571

Note: *p<0.1; **p<0.05; ***p<0.01

Table 6.6: Association between ESG-coverage, SPI and stock liquidity, winsorized at the 99% level.

This table reports the relationship between ESG-coverage, SPI and stock liquidity by using implicit difference-in-differences model. Standard errors are reported in parentheses, clustered by firm.

	Dependent variable:				
	SPI	LIQ_BAS	LIQ_BAS	LIQ_AIR	LIQ_AIR
	(1)	(2)	(3)	(4)	(5)
ESG	0.012**	0.036***		0.162***	
	(0.005)	(0.008)		(0.051)	
$\hat{SPI}$			0.500		2.246
			(0.905)		(1.712)
RET	0.740	2.141***	2.141***	95.822***	95.822***
	(0.614)	(0.535)	(0.535)	(11.153)	(11.153)
ROA	0.024**	−0.069*	−0.069*	−0.268***	−0.268***
	(0.009)	(0.039)	(0.039)	(0.104)	(0.104)
CF	0.00000***	0.00000***	0.00000***	0.00001	0.00001
	(0.00000)	(0.00000)	(0.00000)	(0.00001)	(0.00001)
MCAP	−0.037***	−0.028***	−0.028***	−0.912***	−0.912***
	(0.004)	(0.008)	(0.008)	(0.054)	(0.054)
SIZE	−0.054***	−0.026***	−0.026***	−1.294***	−1.294***
	(0.004)	(0.006)	(0.006)	(0.039)	(0.039)
LEV	0.138***	0.034	0.034	2.383***	2.383***
	(0.013)	(0.022)	(0.022)	(0.120)	(0.120)
Observations	12703	12703	12703	12703	12703
Model	iDiD	iDiD	iDiD	iDiD	iDiD
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Cluster SE	By firm	By firm	By firm	By firm	By firm
Adjusted R^2	−0.011	−0.073	−0.073	0.258	0.258
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 6.7: Association between ESG-coverage, SPI and stock liquidity, winsorized at the 90% level.

This table reports the relationship between ESG-coverage, SPI and stock liquidity by using implicit difference-in-differences model. Standard errors are reported in parentheses, clustered by firm.

	Dependent variable:				
	SPI	LIQ_BAS	LIQ_BAS	LIQ_AIR	LIQ_AIR
	(1)	(2)	(3)	(4)	(5)
ESG	0.012**	0.036***		0.162***	
	(0.005)	(0.008)		(0.051)	
			0.281		2.886
			(0.744)		(1.910)
RET	0.740	2.141***	2.141***	95.822***	95.822***
	(0.614)	(0.535)	(0.535)	(11.153)	(11.153)
ROA	0.024**	−0.069*	−0.069*	−0.268***	−0.268***
	(0.009)	(0.039)	(0.039)	(0.104)	(0.104)
CF	0.00000***	0.00000***	0.00000***	0.00001	0.00001
	(0.00000)	(0.00000)	(0.00000)	(0.00001)	(0.00001)
MCAP	−0.037***	−0.028***	−0.028***	−0.912***	−0.912***
	(0.004)	(0.008)	(0.008)	(0.054)	(0.054)
SIZE	−0.054***	−0.026***	−0.026***	−1.294***	−1.294***
	(0.004)	(0.006)	(0.006)	(0.039)	(0.039)
LEV	0.138***	0.034	0.034	2.383***	2.383***
	(0.013)	(0.022)	(0.022)	(0.120)	(0.120)
Observations	12703	12703	12703	12703	12703
Model	iDiD	iDiD	iDiD	iDiD	iDiD
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Cluster SE	By firm	By firm	By firm	By firm	By firm
Adjusted R^2	−0.011	−0.073	−0.073	0.258	0.258

Note: *p<0.1; **p<0.05; ***p<0.01

7. Conclusion

This thesis provides an important contribution to prior literature on ESG, SPI and stock liquidity in the US stock market. It is the first of its kind to investigate the role ESG rating agencies play in terms of information flow in financial markets. The thesis' overall aim is to establish a causal relationship between first-time ESG ratings and stock liquidity, mediated by SPI. Building upon previous empirical research on similar issues, we hypothesize that (1) firms receiving their first ESG rating will experience a significant increase in SPI compared to firms that do not receive any ESG rating, and that (2) this particular increase in SPI leads to an increase in stock liquidity among the ESG covered firms. Hence, this thesis employs SPI as a key driver in the relationship between first time ESG ratings and liquidity, providing a novel approach to understand the impact ESG rating agencies have on financial markets. Several notable findings arise from the study.

Our empirical analysis shows that first-time ESG ratings are positively associated with SPI at a statistically significant level if 0.1%, indicating that rating agencies serve as dependable sources of ESG information to the US financial market. Specifically, firms that receive ESG-coverage experience an increase of 4.3% in SPI, which is consistent with our first hypothesis. Additionally, we find that ESG-coverage is positively associated with stock liquidity at a significant level of 0.1%, with ESG-covered firms showing an average increase in stock liquidity by 3.5% and 16.5% respectively for each liquidity measure, establishing a positive relationship between ESG-coverage and stock liquidity. However, our analysis does not provide empirical evidence to suggest that this relationship is driven by the elevation of SPI, contradicting our second hypothesis. This indicates that the relationship between ESG-coverage and stock liquidity is more complex and may involve multiple channels such as changes in investor awareness, stakeholder pressure, or corporate reputation. Our findings remain consistent across subsets representing different time periods.

The main limitation of this study is that it relies on a single measure of SPI, namely price nonsynchronicity. While this measure has been widely used in previous studies, it may not capture all aspects of SPI. For instance, price nonsynchronicity may reflect not only the quality of information provided by firms but also other factors such as market microstructure, institutional ownership, or trading volume.

8. Suggestions for Further Research

As highlighted, the increase in ESG-covered firms has been substantial in recent years. However, the role ESG rating agencies play in financial markets still remains unclear. First and foremost, it is natural to suggest further research on the relationship between first-time ESG ratings, stock SPI and liquidity on other US stock exchanges to see if these results are consistent with ours. NYSE[15] is considered as the largest[16] stock exchange in the world (World Federation of Exchanges, 2021), and would thus provide highly valuable data to this field of research. Furthermore, several countries worldwide have implemented ESG goals and regulations. Hence, it would be of academic interest to study both emerging and other developed markets to see if these results differ from the results for the US stock market. Specifically, the European Union (EU) has been instrumental in developing ambitious regulations, such as the EU Sustainable Finance Action Plan (European Parliament and Council 2019),[17] making it highly relevant to study the European stock market. Like NASDAQ and NYSE, Euronext[18] has the potential to provide extensive ESG data from Europe, diversifying this stream of research.

We further suggest conducting comparative studies of different rating agencies to investigate the effect of first-time ESG rating on financial markets across various agencies. In the line of our research, this can help market participants understand how markets value ESG information from different agencies. Additionally, it can signal to stakeholders which agency is considered to have the most effective ESG scoring methodology, which may have implications for various stakeholders. Furthermore, the relation between ESG-coverage, SPI and liquidity can also be studies across sectors, using longitudinal data. This research can benefit rating agency and regulatory authorities in identifying which sectors are most sensitive to disclosure requirements and regulations, which can be effective in changing corporate behaviour. Additionally, it can benefit firms in specific sectors to understand how their ESG activities affect the performance of their stocks.

[15]New York Stock Exchange (NYSE).

[16]According to the 2021 report by World Federation of Exchanges, NYSE had the highest annual trading value in aggregate and highest trading volume, followed by NASDAQ.

[17]The EU Sustainable Finance Action Plan is a regulation adopted on 10 March 2021, and aims to increase transparency and constancy in sustainability reporting in financial markets.

[18]The European New Exchange Technology (Euronext) is the largest stock exchange in Europe, operating exchanges in Paris, Amsterdam, Brussels, Lisbon, Dublin, Oslo, and Milan.

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9. Appendix

Table A.1: Description of all the variables in our data set.

Variable name	**Description**
YEAR	Which year the firm-observation belongs to.
GICS	Global Industry Classification Standard of companies in 11 economic sectors according to their field of business.
SPI	Price nonsynchronicity. Measured as the residual variance from Roll's model.
LIQ_BAS	Relative bid-ask spread. Calculated as the yearly average of the daily bid-ask spread relative to the mid-spread.
LIQ_AIR	Log-transformed Amihud illiquidity ratio.
RET	Stock returns. Calculated as the yearly average of the daily stock returns.
ROA	Return on assets. Calculated as net income divided by assets.
CF	Cash flow. Calculated as the difference between the cash inflows and cash outflows over a specific period of time.
MCAP	Market capitalization. Calculated as the logarithm of the multiplication of the current market price of a company's outstanding shares by the total number of outstanding shares.
SIZE	Firm size. Calculated as the logarithm of a firm's asset value.
LEV	Leverage. Calculated as liability divided by assets.